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ABSTRACT

The solar air heater is a simple device for catching some of the sun's energy to heat a home. Procedures for making and installing such a heater are presented. Included is a materials list, including tools needed for constructing the heater, sources for obtaining further details, and a list of material specifications. (JN)

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INFORMATION
U.S. DEPARTMENT OF ENERGY
CONSERVATION AND RENEWABLE ENERGY INQUIRY AND REFERRAL SERVICE

Build Your Own Solar Air Heater

The solar air heater is a simple device for catching some of the sun's energy to help heat your home. Basically, it's a shallow box, covered with glass or plastic glazing to trap solar energy. The box also contains a black metal absorber plate for changing the sun's radiant energy into heat energy. Between the glazing and the absorber is a dead air space that helps keep captured heat from escaping to the outside air. Behind the absorber is an air chamber through which cool air from the house circulates. This house air passes through an opening behind the solar panel where it is heated as it comes in contact with the absorber. The heated air is then returned to the house through another opening in the panel.

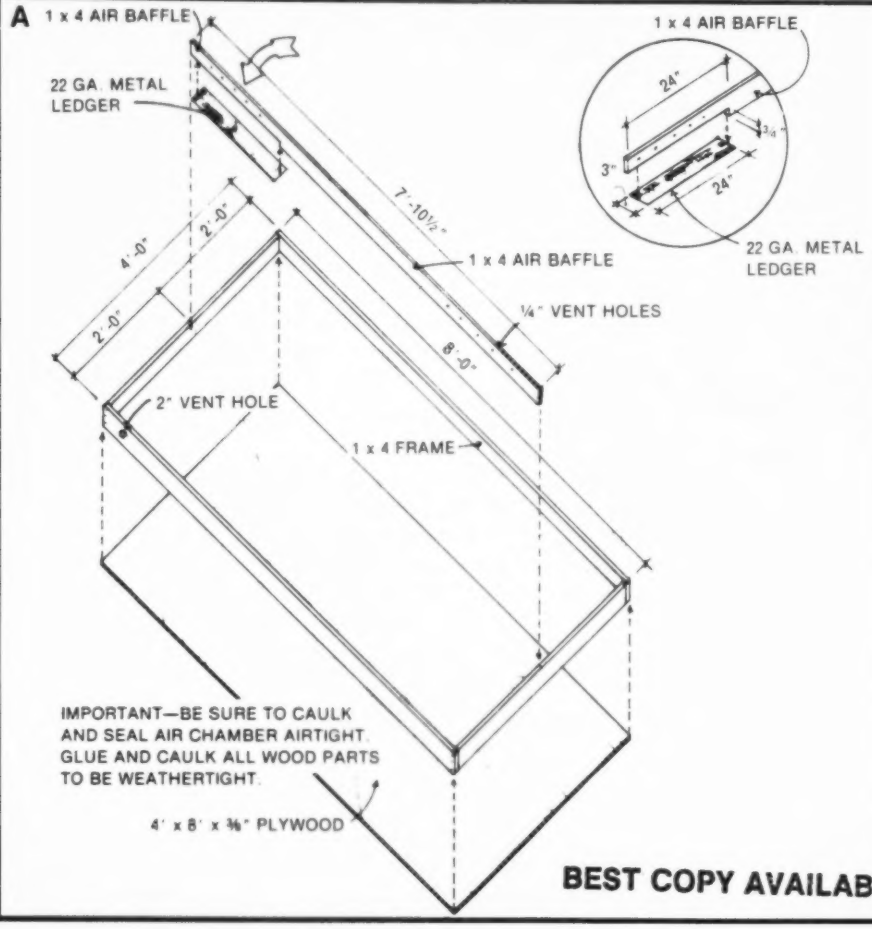
The panel can be mounted in a vertical or horizontal position on the south wall of a house. Mounting the collector there will allow it to catch most of the winter sunlight. The only alteration that will have to be made to the house is the addition of two vents to allow for the openings in the panel. During the winter, the panel should not be shaded by trees or bushes. In summer, the sun is higher in the sky, so most of the sunlight will bounce off the top of the glazing which will prevent overheating.

The solar air heater uses some electricity to power a fan that moves air through the panel. But its's also possible to build a solar air heater that does not use any outside energy. These thermosyphoning systems require larger openings. They also move less heated air as a result of slower natural air circulation. The solar air heater described here performs more efficiently than the thermosyphoning model. The cost of electricity is offset by the increased heat brought into the house.

Construction Procedure

A. 1. Assemble all materials before starting. Read all instructions and be sure you understand each step. A materials list follows the installation instructions.

2. Cut 1 x 4 lumber to length.



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3. Notch center baffle and attach metal ledger to notch with 3/4" nails. Use aluminum ledger and aluminum nails if you use aluminum absorber. Mixing galvanized materials with aluminum will cause electrolysis and corrosion.

4. Cut out 2" diameter hot air vent into dead air space on upper side panel. Install screens and "temp-vents" over the holes on the inside of the frames. This vent opens automatically to ventilate the dead air space when its temperature reaches 150ºF. It opens to prevent overheating in summer and will remain closed during winter operation. As a substitute for "temp-vents" you can cover the holes with corks or wood during winter and remove them during summer. Locate hot air vent on side of panel to prevent rain from entering the opening.

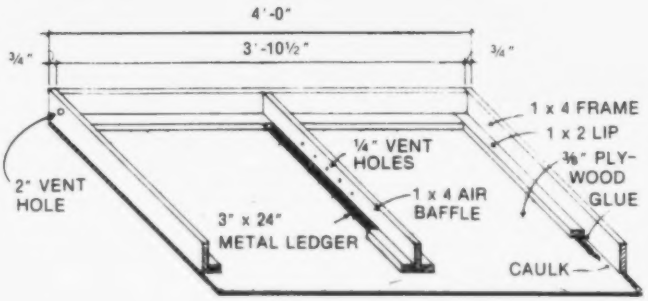
5. Glue and nail 1 x 4 frame and baffle to plywood back. Be sure baffle is centered properly. Caulk with latex caulk where 1 x 4 meets plywood on inside to form a weathertight joint.

B. 1. Cut, glue and nail the 1 x 2 lip into frame.

NOTE: Vent openings in dead air space only. Drill a series of 1/4" vent holes through center 1 x 4 baffle in dead air space and install one temp-vent.

C. 1. Cut absorber metal to size. Use aluminum ledger and aluminum nails if you use aluminum absorber. Clean any grease or oil from metal with detergent or solvent and wash thoroughly. Etch metal with vinegar or muriatic acid so that paint

B



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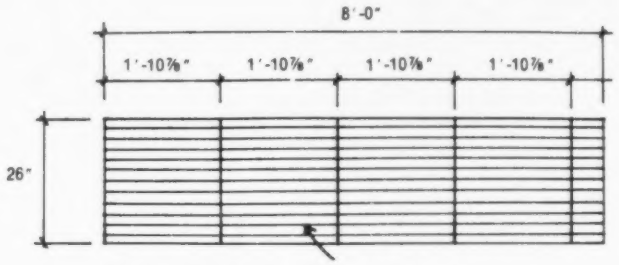

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can adhere to metal. Again, wash metal to remove etching solution.

2. Fasten absorber to 1" x 2" lip with 3/4" galvanized roofing nails every 3". NOTE: Apply a thick bead of silicone caulk onto metal ledger before laying down absorber. This is a "formed-in-place" gasket between the metal ledger and absorber. To keep the absorber embedded in the caulk, drive small nails into the air baffle 1 x 4 to hold absorber down to the ledger. Be sure to put absorber in frame so that corrugations in metal are perpendicular to the air flow. The air in the corrugations will be turbulent allowing more heat to be transmitted to the air from the metal absorber.

3. Paint the absorber and the inside wooden frame with one coat of flat black paint and let dry completely.

4. Carefully silicone caulk the entire edge of the absorber where it meets the wood to form an airtight seal between wood and metal. Use silicone caulk on nail heads to seal nail holes.

D. 1. Touch up any scratches and the flat black paint at nail heads. Turn frame over and paint the back of the plywood and outside of 1 x 4's with exterior house paint to seal lumber.

2. Cut glazing to size, run a bead of caulk on panel 1" x 4's and lay glazing onto panel with ultraviolet protective coating facing out.

3. Cut edging (wood or metal) to length and pre-drill screw holes.

4. Lay edging onto glazing and drill through screw holes into glazing and fasten the edging and glazing to frame with screws. Fasten 4' edge first, center strip next, then sides and final end. Be sure glazing does not extend beyond outer edge of frame to prevent ripples in glazing.

Installation Instructions

This typical installation is for a wood frame home with wood siding. By using lumber, ducts can be made at the house site. For homes with stucco siding, use a masonry blade in your circular saw to cut duct openings. For brick or concrete block siding use a hammer drill (available at tool rental shops) or hammer and cold chisel to cut duct openings.

1. Decide where to locate the solar panel. Check inside walls for electrical outlets and obstructions. Note the floor level inside the home and its position in relation to the outside wall siding to ensure that the duct comes above the inside floor height and not into the floor list area. Locate wall framing to place duct openings between studs.

2. Mark openings for the ducts on the outside wall. Duct openings in the solar panel should be as close to the panel edge as possible. (for a 4" x 12" floor register in the hot air opening of 5 3/4" x 13 3/4" and 4 1/2" x 4 3/4" respectively). Cut rough openings into the outside wall only. Do not cut the inside paneling or sheet rock at this time.

3. Measure the duct length, which is the distance from the extreme outside wall surface to the back of the interior paneling or sheet rock. This measurement is the length of the wall ducts. Rip a piece of 1" lumber to the duct length size. Then cut the duct lumber to size and build the ducts, gluing and nailing them together.

4. Insert the ducts into the wall openings and mark the inside dimensions on the inside wall surface through the duct. Remove the ducts and cut the inside wall openings. By using this method, the interior wall surface will cover the duct edge and no interior trim will be needed.

5. Run a 3' length of wire (No. 2 conductor exterior grade) through the wall from the cool air opening to the hot air opening for later thermostat connecting. Drill a hole into the ducts to run the wire from one duct to the other. Also drill through any studs from the wire run.

6. Latex caulk the inside edge of the ducts liberally and insert the ducts

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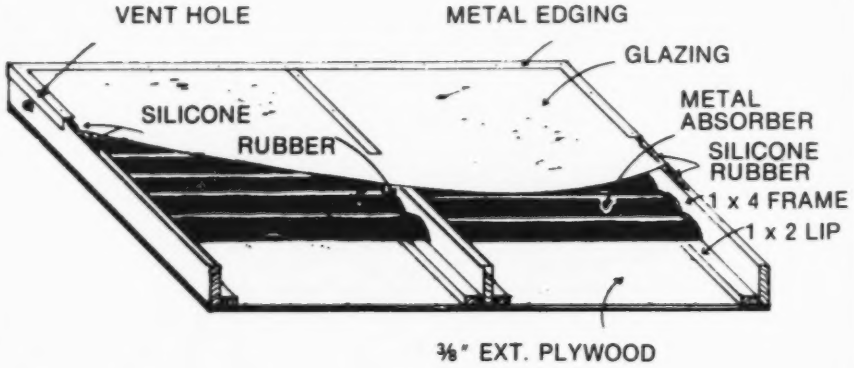

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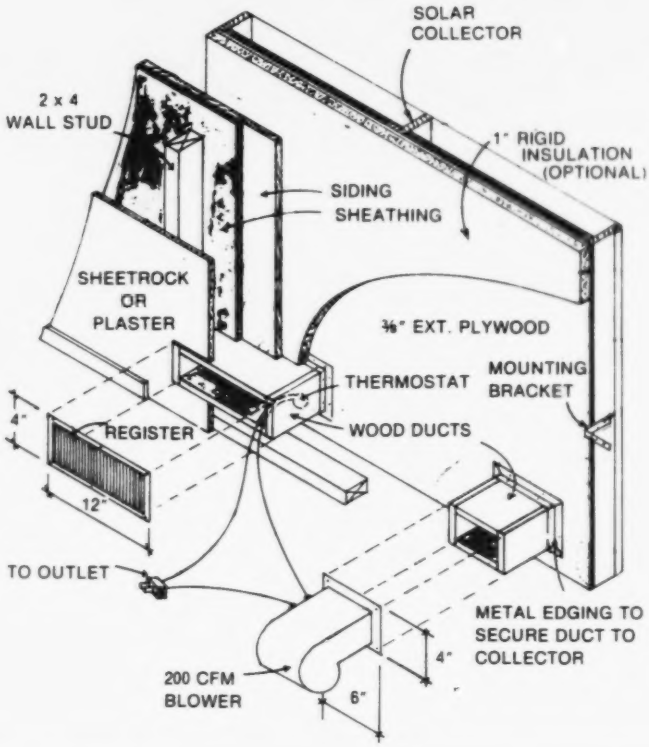

into place, running wire into holes drilled in ducts. Fasten the ducts into place by nailing through ducts into the siding or nearby framing.

7. Caulk the rough openings around the ducts to seal openings from the weather. At this point the wall ducts are in place and the thermostat wire is installed.

8. Next, hold the panel up against the wall and mark the openings for the ducts on the back of the panel by reaching through the ducts from the inside of the house. This method will insure proper panel-to-duct alignment. Be sure to hold the panel straight so that it will look plumb and square once it is fastened to the building. Also, mark the location of the panel on the wall.

9. Lower the panel and cut the duct openings into the back of the panel. Take care not to damage the absorber by cutting or drilling too deep into the back of the panel. Use a circular saw set to a shallow cut or a very short saber saw blade. Now the panel is ready to be mounted on the wall.

10. Latex caulk the outside edge of the ducts and lift the panel into place aligning the panel openings to the ducts. Fasten the panel to the wall with corner braces or angles and screws. Use two corner braces or angles at the top, bottom and sides of the panel to fasten it securely to the wall. Latex caulk the top and sides of the panel where it meets the wall to prevent moisture from getting between the panel and the wall. Paint the wood edge of the panel with a good white exterior house paint or a color to match the siding of the house. At this point the panel is mounted.

11. Inside the home, install the thermostat and blower. Drill a small hole into the absorber in the hot air opening for the self-tapping screw which holds the thermostat in place. Be sure to put the thermostat in the hot air openings so that the thermostat rests securely on the absorber to sense the absorber temperature properly. Connect the two wires to the thermostat connector screws.

12. Latex caulk all seams and joints in the hot air duct to insure an air-tight seal and place the register into the duct. This completes the hot air duct installation.

13. Now latex caulk the cool air duct seams and joints to insure an air-tight seal. Caulk the lip of the blower opening and fasten the blower in place over the cool air opening with the blower intake facing away from the hot air register.

14. Connect one wire from the thermostat to one wire on the blower and tape with electrical tape. Connect the other blower wire and the other thermostat wire to an electrical plug. Be sure all wire connections are clean, tight and safe.

The solar air heater is now installed and ready for operation. Plug the solar air heater into an electrical outlet and adjust the thermostat so that the blower will come on at a temperature which is reached at about 9 a.m. on a sunny morning.

Materials List

This is a list of materials for a 4' x 8' foot solar air heater. Several different choices are listed for some of the items. Also, by using second hand or used materials you should be able to cut the cost of the solar air heater considerably. Just keep the purpose of each item in mind, and you will easily find all the things you need to build the solar air heater.

1 each 4' x 8' x 3/8" CD exterior plywood (this is for the back of the shop-built panel. If you build the panel directly onto the south wall of your home, you can eliminate the backing. Substitute any rigid 4' x 8' panel such as masonite, paneling, etc.)

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4 Each 1" x 4" x 8' pieces of lumber (these form the frame of the panel including baffle)

5 Each 1" x 2" x 8' pieces of lumber (these form the support for the absorber)

Wood Glue

1 Lb. galvanized nails (4D to 6D to fasten the back to the frame)

2 Each 2' x 8' sheet galvanized steel corrugated roofing (absorber plate) NOTE: Absorber steel is cut and fastened with silicone caulk and pop rivets with corrugations running perpendicular to air flow so both sheets will just fit. Corrugated aluminum (either plain or enameled) will work 10% more efficiently than steel. Second hand offset plates available at newspaper printers will work, as will 24" aluminum flashing with some support. If smooth metal is used, be sure to fasten air turbulators beneath the absorber to the wall or back of the panel. Strips of screen molding will work for this.

1 Small bottle of vinegar (muriatic acid or any metal etcher will work. Weathered or used metal does not need to be etched.)

1 Pint Rustoleum or Derusto flat black paint (any moderate temperature paint—(200ºF.)—will work.)

1 Lb. 3/4" galvanized roofing nails or aluminum nails

4 Tubes black silicone caulk sealant (2 tubes will work if you do neat work, but buy 4 tubes just in case. Geocel will work and can be painted black. Clear silicone caulk will work, but cannot be painted.)

2 Tubes Latex caulk

1 Each 3" x 24" piece of metal (to support absorber at center bar opening)

1 Each 4' x 8' piece of flat icy clear fiberglass (Filon). (Kalwall or glass will work. Second hand window glass is a low-cost substitute. Polyethelyne or vinyl clear sheets will work for only a short period of time.)

3 Each 8' long 90 degree angle aluminum, for frame edge to hold down glazing. (3/4" by 3/4" aluminum angle is used. Wooden battens can also be used such as screen molding or any 3/4" wide wooden strip. Flat metal can also be used, but the angled aluminum is best.)

1 Each 8' x 3/4" flat piece of aluminum (substitute with wood as above)

75 Each #7 x 3/4" wood screws

1 Each 8' x 3/4" flat piece of aluminum (substitute with wood as above)

75 Each #7 x 3/4" wood screws

1 Each 200 CFM Squirrel Cage Blower-For best results, use a squirrel cage blower which provides approximately 100 cubic feet per minute at 8" static pressure

1 Each Thermostat (on between 90 to 155 degrees F. and off under 90 degrees)-For thermostat use automatic snap-disc control stock number 2E245, or adjustable thermostatic switch

1 Length 2/12 UG wire (long enough to reach from electric outlet to blower on thermostat)

1 Each Electric Plug

1 Each Temp-Vent for Summer Ventilation

1 Qt. Exterior latex paint to match house color

Assorted lumber and duct tape and insulation for ducting cold and hot registers

Thermostat-low-cost adjustable thermostat, Model #SR-SK-119

1 Each 4" x 12" floor register (substitute screen for hot air opening.)

1 Each 4' x 8' x 1" expanded polystyrene insulation board (needed only if wall is thin or uninsulated)

1 Each Small piece screen (for blower opening)

8 Each 3" x 3" corner braces and screws (for mounting)

Where to Obtain Materials for Your Solar Heater

The major components-thermostats, absorber plate, blowers, glazing, and temp-vent - can be purchased from your local home improvement center or hardward store.

Plywood, lumber, wood glue, nails screws, paint, caulk, corrugated metal, metal for the panel edge and absorber support, electric wire, floor register, and insulation board are also available at local hardware, building supply or lumber stores.

Try your grocery store for vinegar for cleaning the absorber

Building supply stores often stock glazing materials.

Tools Needed for Construction of Solar Heater

Hammer
Tape Measure
Hand or Power Circular Saw
Caulk Gun
Framing Square
Pencil
4 Foot Straight Edge (striaght piece of lumber or rule)
2" or 4" Paint Brush
Rags (for clean-up)
Paint Thinner
Knife
Tin Snips
Drill
Hack Saw
Miter Box
Compass Saw or Saber Saw

For Further Details...

If you have any questions regarding the material in this factsheet contact the Office of Human Concern, P.O. 756, Rogers, Arkansas 72756. The OHC offers a more detailed version of this factsheet for $5.95, that includes an efficiency analysis and suggestions on selecting the site and location for the solar heater. Additional information on solar retrofits (including greenhouses) is available from the Conservation and Renewable Energy Inquiry and Referral Service.

Construction Specifications

General:

Assembly of OHC Solar Air Heater requires both weathertight and airtight construction. The entire unit should be weathertight. Installation on the house must be weathertight to prevent moisture from penetrating between the house exterior siding and the panel. Ducting to and from the panel and the air chamber behind the panel absorber plate must be airtight. Summer hot air vents in the dead air space between glazing and absorber plate must be screened to keep out insects, etc. All wood members must be glued with construction quality glue, fastened with galvanized nails and caulked with quality latex or acrylic caulk, and painted with exterior grade paint. The absorber plate must be prepared with an etching compound before painting to insure proper absorber paint adherence.

Material Specifications:

1. Panel backing should be exterior grade plywood or other exterior grade material.
2. Lumber should be #2 or better, free of knots, checks, splits or other openings.
3. Fasteners should be galvanized or rust resistant.
4. Absorber should be either aluminum or galvanized and free of rust or oxidation.
5. Absorber paint should be able to withstand temperatures up to 200°F.
6. Absorber should be fastened securely to lip and ledger 3 inches on center or closer.
7. Silicone caulk should be used to make a formed-in-place gasket for an airtight seal where absorber fastens to frame.
8. Glazing should be ultraviolet treated if fiberglass is used. Glass should be tempered.
9. Edging on trim should be aluminum, galvanized steel, or a suitable weathersealed wood.
10. Squirrel cage blower should be sized to provide 3 cubic feet per minute per square foot of panel at 1/2 inch static pressure.
11. Thermostat should be weathertight and operate between 85°F and 115°F. Adjustable thermostats within the same temperature range can be used.
12. All wiring should be in accordance with safe practices and building codes.
13. Ducting should be airtight and of suitable material.
14. Aluminum nails or fasteners should be used when aluminum absorber materials are used.

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